

What is claimed is:

1. A retaining ring for chemical mechanical polishing (CMP) apparatus comprising:

5 a body of said retaining ring;

and

a single trigger cavity;

wherein said trigger cavity is formed inside said body of said retaining ring;

and wherein said trigger cavity is configured to indicate that thickness of said
10 retaining ring is less than or equal to a predetermined thickness threshold.

2. The retaining ring of claim 1; wherein said single trigger cavity extends inside
said body of said retaining ring at a depth level that is greater than or equal to a
threshold depth level corresponding to a predetermined thickness threshold.

15

3. The retaining ring of claim 2 further including:

an O-ring covering said single trigger cavity; wherein said single trigger
cavity is filled with gas; and wherein said O-ring prevents said gas from escaping
from said trigger cavity; and wherein said gas is selected from the group
20 consisting of:{air, Helium, Neon, Argon, Krypton , and Xenon}.

4. The retaining ring of claim 2, wherein said single trigger cavity further
includes:

an O-ring covering said single trigger cavity; wherein said single trigger
cavity is filled with fluid; and wherein said O-ring prevents said fluid from

25

escaping from said trigger cavity; and wherein said fluid is selected from the group consisting of: {tap water, alcohols, glycols and water mixes}.

5. A retaining ring for chemical mechanical polishing (CMP) apparatus comprising:

a body of said retaining ring;

and

an integer N of trigger cavities;

wherein a first trigger cavity is formed inside said body of said retaining ring; said first trigger cavity configured to indicate that thickness of said retaining ring is less than a first predetermined thickness threshold;

wherein a second trigger cavity is formed inside said body of said retaining ring; said second trigger cavity configured to indicate that thickness of said retaining ring is less than a second predetermined thickness threshold;

15 and wherein each i-th trigger cavity is formed inside said body of said retaining ring; each said i-th trigger cavity configured to indicate that thickness of said retaining ring is less than an i -th predetermined thickness threshold; i being an integer less than or equal to N.

20 6. The retaining ring of claim 5;

wherein said first trigger cavity extends inside said body of said retaining ring at a first depth level L_1 ;

wherein said second trigger cavity extends inside said body of said retaining ring at a second depth level L_2 ;

25 and wherein each said k-th trigger cavity extends inside said body of said

retaining ring at a k-th depth level L_k ; k being an integer less than or equal to N.

7. The retaining ring of claim 6; wherein $L_1 \geq L_2 \geq \dots L_k \dots \geq L_N$.

5 8. The retaining ring of claim 5 further including:

an integer M of O-rings, each said O-ring covering one said trigger cavity;
wherein each said trigger cavity covered with one said O-ring is filled with gas;
and wherein each said O-ring prevents said gas from escaping from one said
trigger cavity; and wherein said gas is selected from the group consisting of:
10 {air, Helium, Neon, Argon, Krypton, and Xenon}, said integer M being less than
or equal to N.

9. The retaining ring of claim 5 further including:

an integer L of O-rings, each said O-ring covering one said trigger cavity;
15 wherein each said trigger cavity covered with one said O-ring is filled with fluid;
and wherein each said O-ring prevents said fluid from escaping from one said
trigger cavity; and wherein said fluid is selected from the group consisting of:
20 {tap water, alcohols, glycols and water mixes}, said integer L being less than or
equal to N.

20 10. A method of replacing a retaining ring in a chemical mechanical polishing
(CMP) apparatus, said retaining ring comprising a single trigger cavity formed
inside said body of said retaining ring, and an O-ring covering said single trigger
cavity; wherein each said trigger cavity covered with said O-ring is filled with
gas; and wherein said O-ring prevents said gas from escaping from said trigger

cavity; and wherein said gas is selected from the group consisting of: {air, Helium, Neon, Argon, Krypton, and Xenon}; said method comprising the steps of:

- 5 (A) filling said trigger cavity with said gas having a predetermined air pressure;
- (B) substantially continuously measuring and maintaining said predetermined air pressure of said gas in said trigger cavity;
- 10 (C) performing a chemical mechanical polishing operation on a wafer by using said CMP apparatus having said retaining ring with said single trigger cavity under control of a computer loaded with a chemical mechanical polishing computer program;
- 15 (D) if said air pressure in said single trigger cavity changes beyond a predetermined threshold level, using said chemical mechanical polishing computer program to stop said process of performing said chemical mechanical polishing operation on said wafer;
- (E) replacing said retaining ring;
 and
 (F) repeating said steps (A-E).

20 11. The method of claim 10; wherein said step (A) further includes the step of:

- (A1) pumping into said trigger cavity said gas having a predetermined positive air pressure by using said gas compressor; wherein said predetermined positive air pressure is greater than a normal air pressure; and wherein said step
- (D) further includes the step of:

25 (D1) if said air pressure in said single trigger cavity drops below a first

predetermined threshold level, using said chemical mechanical polishing computer program to stop said process of performing said chemical mechanical polishing operation on said wafer.

- 5 12. The method of claim 10; wherein said step (A) further includes the step of:
 (A2) pumping into said trigger cavity said gas having a predetermined negative air pressure by using a vacuum pump; wherein said predetermined negative air pressure is less than a normal air pressure; and wherein said step (D) further includes the step of:
10 (D2) if said air pressure in said single trigger cavity increases above a second predetermined threshold level, using said chemical mechanical polishing computer program to stop said process of performing said chemical mechanical polishing operation on said wafer.
- 15 13. A method of replacing a retaining ring in a chemical mechanical polishing (CMP) apparatus, said retaining ring comprising a single trigger cavity formed inside said body of said retaining ring, and a O-ring covering said single trigger cavity; wherein said trigger cavity covered with said O-ring is filled with fluid; and wherein said O-ring prevents said fluid from escaping from said trigger cavity; and wherein said fluid is selected from the group consisting of: {tap water, alcohols, glycols and water mixes}; said method comprising the steps of:
20 (A) filling said trigger cavity with said fluid having a predetermined fluid pressure by using a fluid pump;
 (B) substantially continuously measuring and maintaining said fluid pressure of said fluid in said trigger cavity;

5 (C) performing a chemical mechanical polishing operation on a wafer by using said CMP apparatus having said retaining ring with said single trigger cavity under control of a computer loaded with a chemical mechanical polishing computer program;

10 (D) if pressure of said fluid pressure in said single trigger cavity drops below a predetermined threshold level, using said chemical mechanical polishing computer program to stop said process of performing said chemical mechanical polishing operation on said wafer;

15 (E) replacing said retaining ring;

20 and

25 (F) repeating said steps (A-E).

14. A method of replacing a retaining ring in a chemical mechanical polishing (CMP) apparatus; said retaining ring comprising: a body; an integer N of trigger cavities; and an integer M of an O-rings; each said O-ring covering one said trigger cavity; wherein each said trigger cavity covered with one said O-ring is filled with gas; and wherein each said O-ring prevents said gas from escaping from one said trigger cavity; and wherein said gas is selected from the group consisting of: {air, Helium, Neon, Argon, Krypton, and Xenon}; wherein said first trigger cavity extends inside said body of said retaining ring at a first depth level L_1 ; wherein said second trigger cavity extends inside said body of said retaining ring at a second depth level L_2 ; and wherein each said k-th trigger cavity extends inside said body of said retaining ring at a k-th depth level L_k ; wherein $L_1 \geq L_2 \geq \dots \geq L_N$, k being an integer less than or equal to N; said method comprising the steps of:

- (A) filling each said trigger cavity with one said gas;
- (B) substantially continuously measuring air pressure in each said trigger cavity;
- (C) performing a chemical mechanical polishing operation on a wafer by using said CMP apparatus having said retaining ring with said plurality of trigger cavities under control of a computer loaded with a chemical mechanical polishing computer program;
- (D) if air pressure in said i-th trigger cavity changes beyond an i-th predetermined threshold level, using said chemical mechanical polishing computer program to issue an i-th warning signal; i being an integer less than N;
- (E) repeating said step (D) for each said i-th trigger cavity;
- (F) if air pressure in said N-th trigger cavity changes beyond an N-th predetermined threshold level, using said chemical mechanical polishing computer program to stop said process of performing said chemical mechanical polishing operation on said wafer;
- (G) replacing said retaining ring;
and
- (H) repeating said steps (A-G).

20 15. A method of replacing a retaining ring in a chemical mechanical polishing
(CMP) apparatus; said retaining ring comprising: a body; an integer N of trigger
cavities; and an integer M of an O-rings; each said O-ring covering one said
trigger cavity; wherein each said trigger cavity covered with one said O-ring is
filled with fluid; and wherein each said O-ring prevents said fluid from escaping
25 from one said trigger cavity; and wherein said fluid is selected from the group

consisting of: {tap water, alcohols, glycols and water mixes}; wherein said first trigger cavity extends inside said body of said retaining ring at a first depth level L_1 ; wherein said second trigger cavity extends inside said body of said retaining ring at a second depth level L_2 ; and wherein each said k-th trigger cavity extends inside said body of said retaining ring at a k-th depth level L_k ; wherein $L_1 \geq L_2 \geq \dots \geq L_k \dots \geq L_N$, k being an integer less than or equal to N; said method comprising the steps of:

- (A) filling each said trigger cavity with one said fluid;
- (B) substantially continuously measuring and maintaining a fluid pressure in each said trigger cavity;
- (C) performing a chemical mechanical polishing operation on a wafer by using said CMP apparatus having said retaining ring with said plurality of trigger cavities under control of a computer loaded with a chemical mechanical polishing computer program;
- (D) if pressure of said selected fluid in said i-th trigger cavity drops below an i-th predetermined threshold, using said chemical mechanical polishing computer program to issue an i-th warning signal; i being an integer less than N;
- (E) repeating said step (D) for each said i-th trigger cavity;
- (F) if pressure of said selected fluid in said N-th trigger cavity drops below an N-th predetermined threshold, using said chemical mechanical polishing computer program to stop said process of performing said chemical mechanical polishing operation on said wafer;
- (G) replacing said retaining ring;
and
- (H) repeating said steps (A-G).

16. A chemical mechanical polishing (CMP) apparatus comprising a retaining ring further comprising at least one trigger cavity formed inside said body of said retaining ring, and at least one O-ring, each said O-ring covering one said single trigger cavity; wherein each said trigger cavity covered with one said O-ring is filled with gas; and wherein each said O-ring prevents said gas from escaping from one said trigger cavity; and wherein said gas is selected from the group consisting of: {air, Helium, Neon, Argon, Krypton, and Xenon}; said CMP apparatus comprising:

- a means for filling each said trigger cavity with said gas having a predetermined air pressure;
- a means for substantially continuously measuring and maintaining said air pressure of said gas in each said trigger cavity;
- a means for performing a chemical mechanical polishing operation on a wafer by using said CMP apparatus having said retaining ring with at least one said single trigger cavity;
- a means for issuance warning signals;
- a means for stopping said (CMP) apparatus;
- and
- a means for replacing said retaining ring with said at least one trigger cavity.

20
25
17. A chemical mechanical polishing (CMP) apparatus comprising a retaining ring further comprising at least one trigger cavity formed inside said body of said retaining ring, and at least one O-ring, each said O-ring covering one said trigger cavity; wherein each said trigger cavity covered with one said O-ring is filled

with fluid; and wherein each said O-ring prevents said fluid from escaping from one said trigger cavity; and wherein said fluid is selected from the group consisting of: {tap water, alcohols, glycols and water mixes}; said CMP apparatus comprising:

5 a means for filling each said trigger cavity with said fluid having a predetermined fluid pressure;

a means for substantially continuously measuring and maintaining said fluid pressure of said fluid in each said trigger cavity;

10 a means for performing a chemical mechanical polishing operation on a wafer by using said CMP apparatus having said retaining ring with at least one said single trigger cavity;

a means for issuance warning signals;

a means for stopping said (CMP) apparatus;

and

15 a means for replacing said retaining ring with said at least one trigger cavity.

20

25